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U. S. DEPARTMENT OF AGRICULTURE.

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FARMERS' BULLETIN No. 108.

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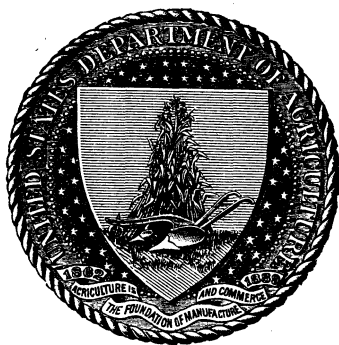
# SALTBUSHES.

BY

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF AGROSTOLOGY,  
*Washington, D. C., November 15, 1899.*

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin, the manuscript of a paper on "Saltbushes," prepared by Dr. P. Beveridge Kennedy, an assistant in this Division. The introduction of several varieties of foreign saltbushes from Australia into California has led to a recognition of the value of these plants for forage and to a consideration of our native saltbushes, of which there are many species growing on the great western plains and semiarid stock ranges of the interior.

Saltbushes are essentially plants of the alkali region here, as in Australia. They are from year to year becoming scarcer on the central plains and cattle ranges of the West through overstocking and trampling of large bands of sheep and cattle. The introduction of foreign species and the preservation of our native varieties are questions of the highest importance, and the present bulletin is designed to draw special attention to these subjects. It need only be added that nearly all the saltbushes produce a great abundance of seeds which germinate readily under ordinary conditions, and when once established the plants will persist and grow through the most trying seasons of drought and heat.

Respectfully,

F. LAMSON-SCRIBNER,  
*Agrostologist.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*

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# SALTBUSHES.

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## GENERAL CHARACTERISTICS.

The saltbushes are herbaceous or shrubby, usually much-branched plants, and show remarkable adaptation to arid, saline, or alkali-impregnated soils. Many kinds are now in cultivation, both native and foreign. Among the most important foreign varieties introduced into this country are Australian saltbush, slender saltbush, gray saltbush, round-leaved saltbush, annual or bladder saltbush, all natives of Australia. The American species of economic value are shad scale, Nuttall's salt sage, spiny salt sage, scrub saltbush, Utah saltbush, tumbling saltbush, and Nelson's saltbush. There are about forty species of saltbushes belonging to the genus *Atriplex* in the Western States some of which will undoubtedly prove to be as valuable as those introduced from Australia. They are known to be hardy as regards cold as well as resistant to alkali and drought, and are highly valued for grazing in alkali districts where little or no other vegetation exists.

The amount of salts occurring in soils varies from 1 per cent to over 12 per cent, or, otherwise expressed, the content may rise as high as 500,000 pounds per acre-foot, but is commonly found to range from about 5,000 to 40,000 pounds. The resistance to, or tolerance of, the several salts by the plants varies greatly for different plants and different salts. Thus the plants of the goosefoot family proper, the beet, spinach, samphire, saltwort, and the saltbushes generally, endure very large amounts of all the salts, while, on the other extreme, the legumes, clovers, peas, beans, vetches, etc., resent even small amounts of any of the salts.

The entire sunflower family is rather tolerant of "alkali," while most of the cultivated grasses are quite sensitive, chiefly owing to their shallow rooting, which exposes them to the evil effects of alkali on the surface.

## DISTRIBUTION OF SEED.

Since 1896 this division has sent out 248 packages of *Atriplex* saltbushes seed to different experimenters throughout the United States. Twenty-nine different States are represented in this distribution. In many instances requests for seed have been made more out of curiosity to see the new forage plant spoken of so highly in the agricultural

papers than from any thought of experimentation or use to be made of the seed. The distribution was as follows:

Shad scale (*Atriplex canescens*), 85 packages; gray saltbush (*A. halimoides*), 37; annual or bladder saltbush (*A. holocarpa*), 29; Australian saltbush (*A. semibaccata*), 20; Nelson's saltbush (*A. pabularis*), 19; slender-fruited saltbush (*A. leptocarpa*), 18; silvery saltbush (*A. argentea*), 16; round-leaved saltbush (*A. nummularia*), 10; bladder saltbush (*A. vesicaria*), 8; Nuttall's saltbush (*A. nuttallii*), 5; Utah saltbush (*A. truncata*), 3; sponge saltbush (*A. spongiosa*), 3, and spiny saltbush (*A. confertifolia*), 3. From the 150 applicants for seed 52 have sent in reports, and, with the exception of 12, all of these report that the seed failed to germinate, or that only a few plants came up and soon died.

This failure to germinate the seeds is very probably due to the methods adopted in planting. If the seeds are harrowed in to the depth of 2 or 3 inches, or sown in drills in alkali soils, they usually rot before germination can take place. The California experiment station (see Bulletin No. 125 of that station) has made extensive investigations and experiments to find out the value of the saltbushes to that State. Within the last eight years about 2,000 pounds of seed have been distributed throughout California in small trial packages. The results are very encouraging and have given ample proof that the saltbushes are valuable pasture and fodder plants and that they are hardy under California conditions.

### HOW TO SOW THE SEED.

The primary rule to remember is that these saltbushes are plants of the desert. Their seeds start easily and rapidly with little or no covering, but the soil must be warm and moist. At the California experiment station, as well as on the trial grounds of the Department at Washington, D. C., it has been determined that the seeds germinate better when sown directly on the surface without any covering. Some practical stockmen have had good results in establishing saltbush on alkali ranges by sowing the seed on the ground when it was wet with heavy rains and at once driving a flock of sheep over the land, thus treading the seed into the soil. In order to obtain a satisfactory stand, however, the heat must be adequate. When once established the plant produces an abundance of vegetative growth which covers the ground very thickly.

Almost without exception farmers who have attempted to cover saltbush seed on alkali soils have found that it rotted in the ground before germination could take place. For California the best time to sow is about the latter part of September or the beginning of October, when one is able to catch the first autumn showers. Plants may be grown

by sowing the seed in boxes or garden beds, covering very lightly, and planting out the seedlings several feet apart when a few inches high on alkali spots. Many have followed this method with success, and thus have utilized every seed obtained. In districts where the seed is being experimented with for the first time and in the case of small lots this method is to be recommended.

As the saltbushes are remarkable for their ability to adapt themselves to varied conditions, this method would assist the plants and seed to become acclimated and thus more likely to insure germination than if sown broadcast directly on the ground for the first trials. The California experiment station sums up the points in brief as follows: Sow early, on the surface; press seed into the soil, but do not cover; protect from birds, which are very fond of the seeds.

Although no extensive experiments have been made with sowing saltbush seed on nonalkaline soils, yet it seems to be an advantage to cover them slightly.

### INTRODUCED SALTBUSES.

**Australian saltbush** (*Atriplex semibaccata*, fig. 1).—A vigorous, rapid-growing, much-branched perennial which forms a dense mat over the ground to the depth of from 1 to 2 feet. The leaves are

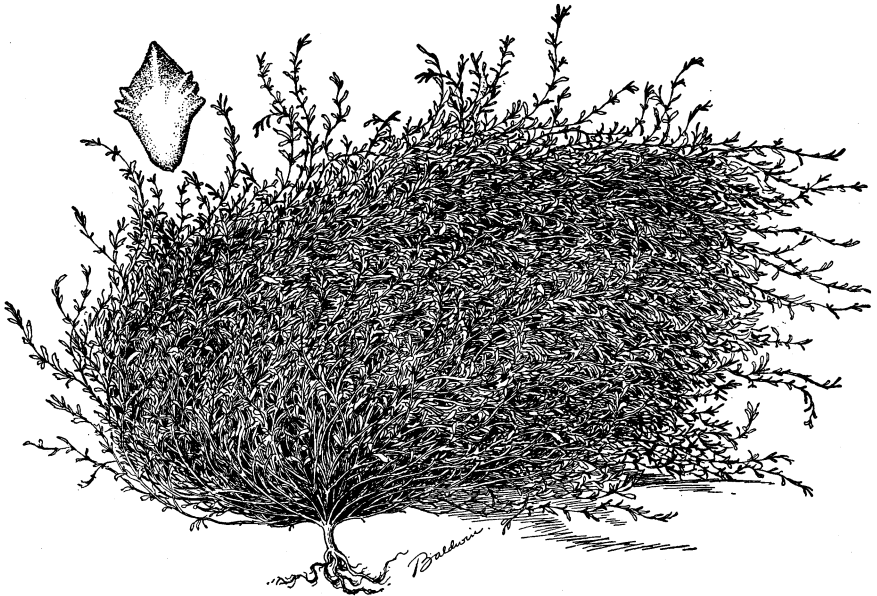


FIG. 1.—Australian saltbush (*Atriplex semibaccata*) grown in the grass garden of the Department of Agriculture.

small, about an inch long, and coarsely toothed along the margins. In a few weeks one plant will spread from 4 to 5 feet, covering a large area. The hard, somewhat pulpy fruits are produced in great abun-



dance throughout the season. They differ from many of the other saltbushes in not having the seed surrounded by a large light fibrous covering, but merely a very thin coating of pulp which is tinged with red at maturity and dries out as soon as they fall from the plant. On the poorest and most stubborn arid soil, so impregnated with alkali that no other useful plant will grow, this saltbush has been known to flourish. It seems to have a remarkable number of virtues, including great frost resistance, palatability, heavy yield, sand-binding qualities, and the habit of spreading freely. Sheep are especially fond of this saltbush and hogs eat it freely. A mixture of three parts of this forage with one part of common hay is readily eaten by horses and cattle. It is probable that about 20 tons of green feed or 5 tons of cured forage could be produced from one acre. The introduction of this plant to owners of waste alkali lands has certainly been a great achievement. As it has almost the same nutritive ratio as alfalfa, it would seem that it must have nearly as high a feeding value. Von Mueller states that, in his opinion, many of the valuable qualities of the Australian wools are due to the abundance of this and other saltbushes in the regions in which the sheep are grazed. Owing to its thin, flexible stems it can be handled like alfalfa, while most of the other saltbushes are only fit for browsing. Of all the different species in cultivation in this country this Australian saltbush seems to be the most promising, both because of its hardiness and the bulk of tender fodder produced.

Mr. James K. Metcalfe, Silver City, Grant County, N. Mex., testifies as follows:

I had four plants from last year's planting. It spread 8 feet wide and made a great many seeds. It will succeed when we have spring and fall rains.

The following testimonies taken from the Report of the University of California experiment station for 1895-96, 1896-97 show clearly the great value and wide adaptability of the plant:

*J. L. Ginn, Clarks, Nebr.:* Australian saltbush seeds nearly all grew, making a fine growth. The bush grew to be about 4 feet across. I think it is well adapted to our alkali soils, except that they are rather wet at times. I do not know how well it stood the winter. It bore seeds, but I did not gather them.

*E. W. Dalton, Plain City, Weber County, Utah:* The saltbush seed was planted, some in pans, as you recommended, others in the open ground. That which was planted in the ground did the better, but did not grow as it does in your section. Some of the plants grew to be 8 or 9 inches high, and spread over the ground from 1 to 2 feet. It was planted on mineral land where scarcely anything else would grow.

*H. B. Enos, San Antonio, Tex.:* I have been trying saltbushes near San Antonio, Tex., for the past eight months in light soil without water, and they have made a growth of about 4 feet from small plants, 2 inches high. I know they will stand the droughts of Texas.

*C. de Foresta, Dorsey, N. Mex.:* I first planted Australian saltbush in boxes and afterwards transplanted. The plants grew well and spread out nicely. The winter cut them low to the ground, but this spring new plants are coming up around the old stumps; so that after all it may prove to be useful in this locality.

In the grass garden at the Department of Agriculture, Washington, D. C., the Australian saltbush has produced a vigorous and widely spreading growth all the season. It is now fruiting abundantly, and extends 5 feet beyond the original plot which it has now occupied for five years without reseeding or other care.

**Round-leafed saltbush** (*Atriplex nummularia*).—A tall, shrubby perennial, sometimes reaching a height of from 6 to 10 feet, and covered all over with downy, whitish scales. The leaves are variable, but are mostly round, rather thick, and toothed along the margins. The plant is dioecious—that is, the two sexes of the flowers are borne on separate individuals. Although it is extensively planted and highly valued in Central Australia and South Africa, the experiments with it

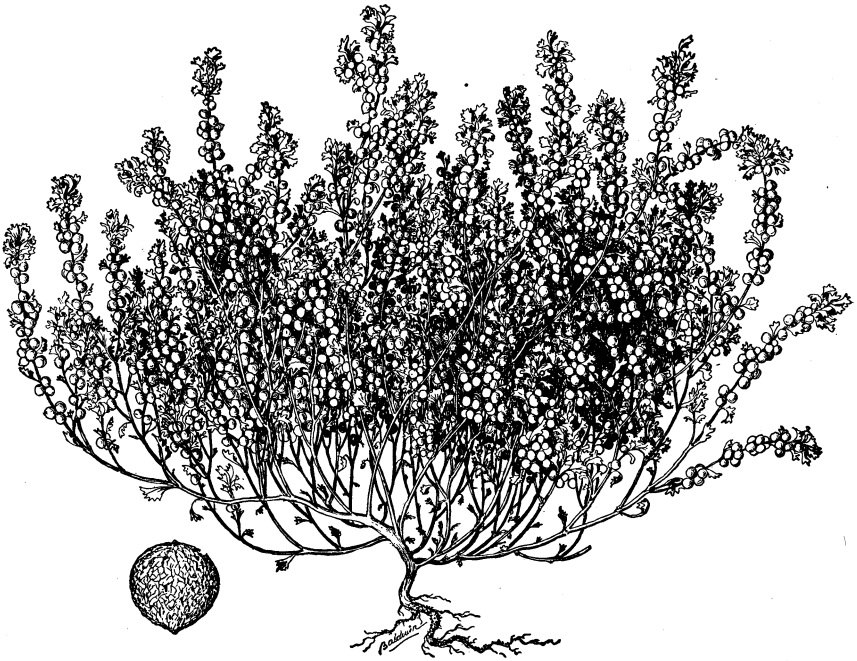


FIG. 2.—Annual saltbush (*Atriplex holocarpa*) grown in the grass garden of the Department of Agriculture.

in this country have not been very satisfactory. This was one of the first saltbushes introduced into California, but it has never made fertile seed in this country. Seeds obtained from Australia, both here and at the University of California, have twice failed to germinate. In Australia live stock are reported to be exceedingly fond of it, and its drought-enduring qualities are remarkable. As it seeds freely and volunteers readily in Australia and South Africa, there is but little doubt that by further experimentation in different parts of this country it may yet prove its adaptability to some of the arid districts of the Southwest.

**Annual saltbush** (*Atriplex holocarpa*, fig. 2).—A low, densely branch-

ing annual, about a foot high, with larger and fewer leaves than Australian saltbush. The seeds are surrounded by a brown, fibrous spongy covering and are readily blown about by the wind, so that the plant can soon become widely disseminated. This species has not received the attention which it deserves. In the grass garden of the Department of Agriculture it has made a vigorous growth for several seasons from self-sown seeds, which are produced abundantly. On July 22 it was growing vigorously at the tips of the branches, while at the same time the ground was covered to a depth of 1 inch with the fallen seeds. Three pecks of seeds have already been collected from a 5-foot square plot, and before the season closes one-half bushel more will be gathered. It has also made excellent growth under adverse conditions on the experiment grounds at Abilene, Tex. In spite

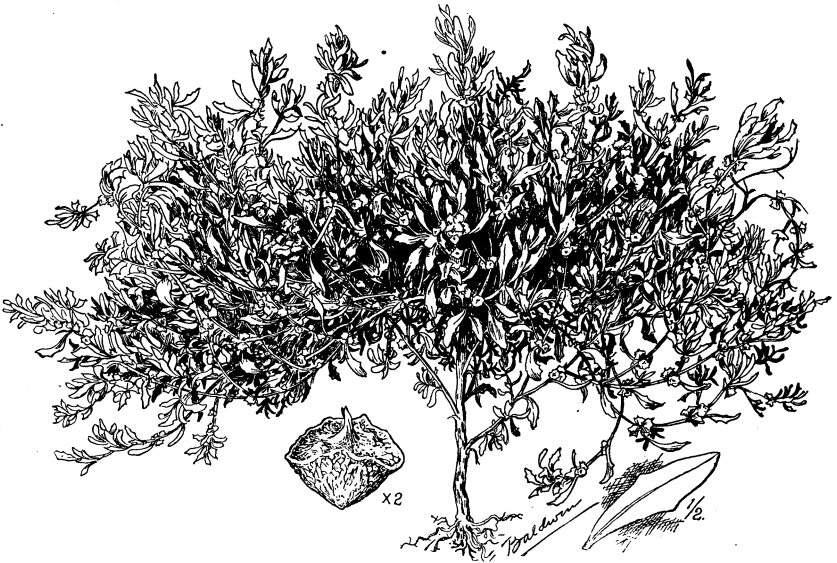


FIG. 3.—Mealy or gray saltbush (*Atriplex halimoides*).

of the worst drought that has ever been known in that part of Texas, this plant continued to mature leaves and seeds throughout the entire summer.

**Mealy or gray saltbush** (*Atriplex halimoides*, fig. 3).—A low-growing, shrubby, robust perennial about 1 foot high, with variable, ovate-lanceolate leaves which are covered with whitish, dust-like scales. The seed has a spongy, fibrous covering similar to Annual saltbush, but instead of being round is peculiarly angled. It is a native of the central desert regions of Australia. It makes a very rapid growth and begins to bear seed in three months after sowing. In Australia it affords excellent forage both for sheep and cattle, which fatten remarkably well on it. In this country it has not been sufficiently experimented

with to state here its possibilities. It promises, however, to surpass the Australian saltbush on dry lands, and gives indications of being valuable on so-called desert situations. In the grass garden of the Department of Agriculture this species has made a good growth, and will no doubt be of considerable value on non-alkali soils.

**Slender saltbush** (*Atriplex leptocarpa*, fig. 4).—A much-branched trailing perennial, closely resembling Australian saltbush. The whole plant is covered with a glaucous bloom. The leaves are very variable in shape, but mostly oblong, and from 1 to 2 inches in length. The fruit is small, narrow, cylindrical, and prominently two-pointed at the apex. There are about 10,000 seeds to the pound. This species was introduced into California in 1891 and has since become widely distributed. In Australia it is found growing more abundantly than *A. semibaccata*, sometimes carpeting the ground over considerable areas. Von Mueller says that its drought-resistant qualities are remarkable. It promises to be a valuable plant for this country, and will probably do better for regions near the coast than the Australian saltbush. It does not seem to do well on hard-pan lands.

**Bladder saltbush** (*Atriplex vesicaria*).—An erect, bushy shrub, 18 inches to 2 feet high, and covered with a white scaly dust. The leaves are about three-fourths of an inch long and oblong in shape. The fruit is membranous, with large, inflated, angled, bladder-like appendages on each side, hence the name "bladder saltbush." In Australia this species

is considered one of the most valuable forage plants, because of the abundance of seed which it produces and the ease with which the seeds are spread about. It withstands the utmost extremes of drought. It was introduced into Europe a number of years ago and is now extensively grown throughout the south of France, where it is much valued for sheep. The plant is said to be readily propagated by cuttings made from the half-ripened wood, as well as by the seed. This seems to be one of the most promising species of recent introduction into California, but further experimentation is necessary. It will probably prove of value in the Mojave and Colorado deserts. The seed should be lightly covered.



FIG. 4.—Slender saltbush (*Atriplex leptocarpa*).

The following saltbushes have been recently introduced into this country from Australia, but their value has not yet been determined:

Sponge saltbush (*Atriplex spongiosa*); Kidney-fruited saltbush (*A. stipitata*); angular-fruited saltbush (*A. angulata*); small saltbush (*A. campanulata*); *A. velutinella*; and *A. kochiana*.

#### AMERICAN SALTBUSSHES.

**Shad scale** (*Atriplex canescens*, figs. 5, 6).—A robust, shrubby perennial from 4 to 10 feet high, native of the high valleys and plains

of Wyoming, Nevada, Arizona, New Mexico, and western Texas. The small, narrow, gray-green leaves and young branches are browsed by cattle, which sometimes eat it down close to the ground, leaving only the stump to branch out again into new growth. The seeds are produced in great abundance, often one-half bushel or more on a plant. These are much sought after by sheep and are considered very fattening.

In the Southwest there are large sections of country where shad scale constitutes the chief forage plant. It is so much liked by stock that on the summer ranges it matures only on rocky cliffs or other inaccessible points. On ranges which are not grazed through the summer, where the plant has an opportunity to seed freely, it grows in great abundance and affords excellent winter pasturage.



FIG. 5.—Fruit and flower of shad scale (*Atriplex canescens*); a, fruit; b, flower.

It has proved its adaptability to soils impregnated with white alkali and also withstands small amounts of the black alkali. Its resistance to cold adds greatly to its value.

**Nuttall's saltbush** (*Atriplex nuttallii*, fig. 7).—A shrubby perennial, 2 to 3 feet high, with spreading branches and numerous thick, succulent leaves. It is the most common saltbush of the plains of northern

Colorado, Wyoming, Montana, and northern Nevada, and is considered by stockmen the most valuable plant of that region for winter pasturage. The plant endures much severe tramping and hard usage. In the Red Desert of Wyoming it supplies fully one-half of the winter grazing. Nelson<sup>1</sup> states that the leaves and young twigs, and especially the seeds, are very fattening, and sheep eat the forage both green and when it has cured upon the ground. Nuttall's saltbush is worthy of introduction into cultivation along with the Australian saltbushes, and wherever it now occurs on the ranges care should be taken not to exterminate it by overstocking.

**Spiny saltbush**

(*Atriplex confertifolia*).—A

shrubby, spreading perennial, from 15 to 20 inches high, with numerous short, thick leaves and spiny branches. It produces enormous quantities of flat, winged seeds, and is native to the high plains of Nevada, Utah, and Wyoming, where it furnishes a considerable part of



FIG. 6.—Shad scale (*Atriplex canescens*).

the winter forage. The leaves and fruits drop off in autumn and are collected in depressions in the ground or form little wind drifts behind the bushes. These little piles of leaves and fruits are the first to be eaten by the sheep and cattle when they enter the winter pastures. The spiny branches are also browsed to the ground.

**Utah saltbush** (*Atriplex truncata*).—A low-growing, much-branched annual, with the habit of Australian saltbush, covering the ground

<sup>1</sup> Bul. No. 13, Division of Agrostology.

with a thick mat of leaves. It grows luxuriantly on clay soils impregnated with common salt and white alkali. It would yield a large quantity of fodder if cut before maturity. Wherever cattle have access to it they graze it so closely that it is difficult to find seed in any quantity. It is never abundant excepting in localities protected from overgrazing or in regions inaccessible to stock.

**Tumbling saltbush** (*Atriplex volutans*).—A rank, leafy annual, 2 to 3 feet high, forming an upright compact mass. It produces a great abundance of seed. Nelson says that it may prove more valuable for certain alkali soils than any of the foreign species. It gets its name from the fact that, like a great many other plants native to the western plains and prairies, the stem breaks off close to the ground in autumn and the plant goes rolling over the country, scattering its seeds at every bound. This might be raised as an objection to its being brought into cultivation, as it might prove a 'bad weed' in grain fields. It has very little forage value after the seeds have fallen.

**Nelson's saltbush** (*Atriplex pabularis*).—An erect perennial, 8 to 16 inches high, which puts out a great many slender stems



FIG. 7.—Nuttall's saltbush (*Atriplex nuttallii*).

from the roots each year and produces a large number of succulent leaves and fruit. It has been collected only in the Red Desert of Wyoming and promises to be a valuable fodder plant for strongly alkaline soils.

### COMPOSITION OF THE SALTBUSHES.

**Composition of the ash.**<sup>1</sup>—The saltbushes show a higher percentage of ash than most of the green fodders. The following will indicate the percentage of ash in air-dried Australian saltbush (*Atriplex semibaccata*) as compared with air-dried alfalfa and timothy:

<sup>1</sup> Compiled from Bul. No. 125, California Agr. Exp. Station.

Australian saltbush, 19.37; California alfalfa, 6.43; timothy, 6.15. It is thus seen that the saltbush far exceeds in percentage of ash that of either timothy or alfalfa. The percentages of potash and phosphoric acid in the ash of the saltbush are each less than in either of the other plants. Although the percentages of these two very important ingredients are somewhat low, the actual amounts contained in the ash from a crop of saltbush are far in excess of those found for an ordinary crop of hay. Again, while it is true that the percentages of potash and phosphoric acid are less in the ash of the saltbush than in that of the other plants when calculated on the same amount of ash, yet the percentage of ash being much greater in the saltbush, there will be withdrawn from the soil more potash by a ton of saltbush than by the same weight of the others.

The amounts of soil ingredients withdrawn from the soil by saltbush, alfalfa, and timothy, respectively, are indicated in the following table:

	Total ash.	Potash.	Phos. acid.	Lime.	Nitrogen.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Saltbush, in 1,000 pounds.....	193.70	21.30	5.93	11.14	18.60
Alfalfa, in 1,000 pounds.....	65.00	13.49	6.43	22.86	22.50
Timothy, in 1,000 pounds.....	61.50	17.71	6.64	5.72	15.40

The total ash of 1,000 pounds of saltbush, as indicated above, is more than three times that removed in 1,000 pounds of timothy and more than two and a half times that removed in 1,000 pounds of alfalfa. The amount of potash removed from the soil by the saltbush is greatly in excess of the quantity withdrawn by alfalfa and more nearly that of timothy. The phosphoric acid is about the same in all cases. With reference to lime, it seems that a crop of alfalfa withdraws considerably more of this ingredient than either saltbush or timothy hay. The highest figure for nitrogen is alfalfa with 22½ pounds per thousand, while saltbush removes about two-thirds of this amount. It therefore appears that while the saltbush removes an enormous quantity of ash from the soil, it does not "correspondingly" draw upon the vital ingredients.

## FOOD VALUE OF THE SALTBUSES.

*Composition of different fodders.*

Name.	Percentage composition.					
	Moisture	Pure ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Crude fat.
<b>Green:</b>						
Australian saltbush.....	78.03	4.58	2.75	3.75	10.41	0.48
Round-leaved saltbush.....	75.00	7.82	4.11	1.81	10.71	.55
Alfalfa.....	75.04	1.80	4.91	6.34	11.09	.86
<b>Hays:</b>						
Australian saltbush.....	7.05	19.37	11.64	15.88	44.05	2.01
Round-leaved saltbush.....	10.00	28.15	14.79	6.51	38.55	1.98
Alfalfa.....	10.95	6.43	17.60	22.63	39.31	3.08



The value of the saltbush will be better appreciated when it is remembered that in the selection of foods the chief nutrients to be considered are the protein compounds or nitrogenous ingredients. They are indispensable to the healthy and vigorous growth of the animal body, for animals which have been deprived of all nitrogenous materials die in a very short time. That the saltbushes range high in these most important ingredients will be seen by an examination of the fodder in a green state, as shown by the table of composition of different fodders just preceding. It will be seen that the round-leaved saltbush is much richer in protein than the Australian saltbush, the former almost equaling that of alfalfa. Much further experimentation, particularly as to digestibility, will be required before any definite statements can be made in regard to the nutritive value of the saltbushes. The choice of the best species to be grown in a special locality will depend on its adaptation to the soil and the feeding value of the forage.

Considerable variation is to be noticed in the percentage of crude fiber in the three different fodders. As this ingredient is very indigestible, it is an advantage to have as little of it as possible. The round-leaved saltbush appears to be the most desirable in this respect, as it has only 1.81 per cent of woody fiber, while the Australian saltbush has 3.75 per cent and alfalfa 6.34 per cent.

Feeding experiments have not as yet been carried on to such an extent with the saltbushes as to enable us to state their digestibility. It is not advisable to feed the saltbush hay alone, owing to the high percentage of salt ingredients and its general uninviting appearance. Any alteration in the food of an animal should be made gradually. The best plan is to feed a little of the saltbush hay at first with a considerable quantity of the meadow hay, then by degrees gradually diminish the amount of the latter until the proportions are about equal.

It has been found that the green saltbush can be advantageously utilized to feed along with straw, making the latter more palatable.

### MISCELLANEOUS ALKALI PLANTS.

**Winter fat; Sweet sage** (*Eurotia lanata*, fig. 8).—A half-shrubby perennial, 1 to 3 feet high, with numerous small gray leaves and slender woolly twigs. It is found growing wild throughout the Rocky Mountain region from British Columbia to Mexico. An important fact in regard to this plant is that it will thrive on both alkali and nonalkali soils. In western Texas and in the more arid regions of Arizona, Nevada, and Utah it is very highly valued for winter forage. The cottony seeds are produced in great abundance, and both seeds and stems are eaten greedily by all grazing animals, so that this plant is now almost exterminated wherever cattle have free range.

It has been growing in the grass garden of the Department of Agriculture at Washington, D. C., for several years, and grows almost as well in dry as in wet weather, producing a fine growth of forage. Stock grazed on lands where winter fat occurs make a rapid growth, and are said to be remarkably free from disease because of the tonic properties of the plant. Seed might be gathered by ranchmen and sown in the spring on land which had been disked or harrowed, and while it could not be cut for hay owing to its shrubby nature, yet it would make excellent winter browsing for either sheep or cattle.

**Greasewood** (*Sarcobatus vermiculatus*, fig. 9).—There are a number of thorny shrubs which are characteristic of strongly alkaline soils, and which go under the name of "greasewood." The most common in the Rocky Mountain region is the above species, which is also known in the Southwest as the chico plant. It is an erect, scraggy shrub, 2 to 8 feet high, with numerous narrow leaves 1 to 1½ inches long. Many of the young shoots and branches are provided with thorns. It develops a thick taproot that goes down 15 to 20 feet or more into the soil, and sends out lateral roots to a distance of 8 to 12 feet. Greasewood will thrive in soils which contain an amount of black alkali that would not be tolerated by any cultivated crops. Western ranchers recognize the general rule that lands covered with greasewood can not be profitably reclaimed.

**California greasewood** (*Allenrolfea occidentalis*).—This is an entirely different plant, but like the preceding, is one of the characteristic black-alkali plants. Reports vary as to its value for forage. Some state that it is never touched by stock, while others say that it is browsed to some extent in winter.



Fig. 8.—"Winter fat," or Sweet sage (*Eurotia lanata*).

### ALKALI AND ALKALI SOILS.

There are extensive areas in all the States west of the one hundredth meridian which contain more or less alkali in the soil. The term alkali is commonly applied to soils which have an accumulation of salts on the surface. These salts vary considerably both in their composition

and their effect on vegetative growth. The soda-salts, unlike those of potash, do not enter readily into combination with the clays which are present in most soils. They remain free, and being readily soluble in water are more liable to cause injury to plant growth through excessive accumulation.

The results of investigations by Hilgard and Whitney show us the reasons for this accumulation of salts in arid soils, and their nonoccurrence in the soils of humid regions. In the arid and desert-like regions the rainfall is only sufficient to penetrate to the depth of a few feet, and if there is insufficient moisture to wet the subsoil the salts can not be leached out in the drainage waters, as is the case in humid climates. A heavy rain falling on an alkali soil dissolves the salts on

the surface, but instead of being carried off with the surface drainage they remain behind, only to accumulate at the surface again as soon as the moisture evaporates.

Alkali soils are naturally rich in mineral plant foods. If the percentage of these salts can be reduced to a certain limit in the soil, crops could be grown upon them for a great many years without materially exhausting their fertility.

There are two kinds of alkalies occurring in soils, the white and the black alkalies. The black alkali is the most injurious to vegetation, as it eats into the seeds, preventing germination, and also attacks living plants just above the surface of the ground. It is only by the effects of the black and the white alkalies upon the soil or vegetation that any difference between them is

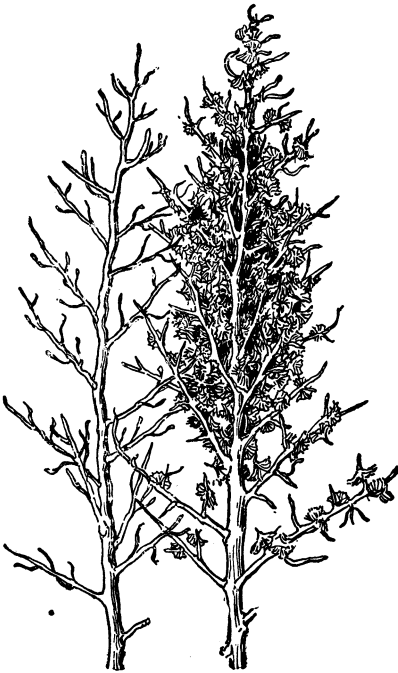


Fig. 9.—Greasewood (*Sarcobatus vermiculatus*).

perceptible to the eye. The idea seems to prevail among farmers that the appearance of a white crust upon their lands means the presence of black alkali, and that therefore gypsum must be applied to counteract it. This is a serious error, but it is one that any person is liable to make so long as no special examination has been made of the soil. Now, it is only upon the black alkali that the gypsum can have any action. If applied to a soil in which there is no black alkali, the application is only a useless expenditure of money, time, and labor, so far as the counteracting of the alkali is concerned. Farmers should first ascertain the nature of the alkali with which they are troubled before purchasing gypsum.

## CONCLUSIONS.

There are extensive areas of land so strongly alkaline that none of the cereals, grasses, or clovers will grow on them. These lands contain three different salts—common salt, Glauber's salt, and sal soda or black alkali. The black alkali is the most injurious to vegetative growth.

Saltbushes will grow on many of these lands and produce a considerable amount of excellent forage.

The introduction of the Australian saltbushes has proved to be of great value to owners of waste alkali lands. A crop of Australian saltbushes will produce from 15 to 20 tons of green food per acre, or about 3 to 5 tons of dry forage.

The seed may be sown on alkali soils any time during the spring or summer months. It should be sown on the surface and pressed in.

It is very essential for the soil to be warm. For trials in new districts it is preferable to sow the seed in boxes and then transplant.

Many of the saltbushes will grow well on nonalkali soils. It has been found to be an advantage to cover the seeds slightly on such lands.

When once established the saltbushes are able to withstand very severe drought.

Many lands impregnated with black alkali may be reclaimed and made to produce ordinary crops by properly proportioned dressings of gypsum. By planting and cropping saltbush large amounts of alkali are removed from the soil. Soils which are slightly too alkaline for the growth of cereals may be relieved in a few years by this method.

The protein compounds in a feeding stuff go to form blood, muscle, and sinew, and on this account are often called "flesh-formers." The saltbushes compare very favorably with other foods in these most important ingredients.

The digestibility of saltbushes is probably about the same as that of oat hay. Horses, cattle, sheep, hogs, goats, and chickens thrive on them.

The saltbushes are more or less succulent, and care should be taken not to allow stock to gorge themselves when first turned out on the pastures.

The forage may be fed in the green state with straw, to the great improvement of the palatability of the latter.

## FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

No. 16. Leguminous Plants for Green Manuring and for Feeding. No. 19. Important Insecticides: Directions for their Preparation and Use. No. 21. Barnyard Manure. No. 22. Feeding Farm Animals. No. 23. Foods: Nutritive Value and Cost. No. 24. Hog Cholera and Swine Plague. No. 25. Peanuts: Culture and Uses. No. 26. Sweet Potatoes: Culture and Uses. No. 27. Flax for Seed and Fiber. No. 28. Weeds; and How to Kill Them. No. 29. Souring of Milk and Other Changes in Milk Products. No. 30. Grape Diseases on the Pacific Coast. No. 31. Alfalfa, or Lucern. No. 32. Silos and Silage. No. 33. Peach Growing for Market. No. 34. Meats: Composition and Cooking. No. 35. Potato Culture. No. 36. Cotton Seed and Its Products. No. 37. Kafir Corn: Characteristics, Culture, and Uses. No. 38. Spraying for Fruit Diseases. No. 39. Onion Culture. No. 40. Farm Drainage. No. 41. Fowls: Care and Feeding. No. 42. Facts About Milk. No. 43. Sewage Disposal on the Farm. No. 44. Commercial Fertilizers. No. 45. Some Insects Injurious to Stored Grain. No. 46. Irrigation in Humid Climates. No. 47. Insects Affecting the Cotton Plant. No. 48. The Manuring of Cotton. No. 49. Sheep Feeding. No. 50. Sorghum as a Forage Crop. No. 51. Standard Varieties of Chickens. No. 52. The Sugar Beet. No. 53. How to Grow Mushrooms. No. 54. Some Common Birds in Their Relation to Agriculture. No. 55. The Dairy Herd: Its Formation and Management. No. 56. Experiment Station Work—I. No. 57. Butter Making on the Farm. No. 58. The Soy Bean as a Forage Crop. No. 59. Bee Keeping. No. 60. Methods of Curing Tobacco. No. 61. Asparagus Culture. No. 62. Marketing Farm Produce. No. 63. Care of Milk on the Farm. No. 64. Ducks and Geese. No. 65. Experiment Station Work—II. No. 66. Meadows and Pastures. No. 67. Forestry for Farmers. No. 68. The Black Rot of the Cabbage. No. 69. Experiment Station Work—III. No. 70. The Principal Insect Enemies of the Grape. No. 71. Some Essentials of Beef Production. No. 72. Cattle Ranges of the Southwest. No. 73. Experiment Station Work—IV. No. 74. Milk as Food. No. 75. The Grain Smuts. No. 76. Tomato Growing. No. 77. The Liming of Soils. No. 78. Experiment Station Work—V. No. 79. Experiment Station Work—VI. No. 80. The Peach Twig-borer—an Important Enemy of Stone Fruits. No. 81. Corn Culture in the South. No. 82. The Culture of Tobacco. No. 83. Tobacco Soils. No. 84. Experiment Station Work—VII. No. 85. Fish as Food. No. 86. Thirty Poisonous Plants. No. 87. Experiment Station Work—VIII. No. 88. Alkali Lands. No. 89. Cowpeas. No. 90. The Manufacture of Sorghum Sirup. No. 91. Potato Diseases and Their Treatment. No. 92. Experiment Station Work—IX. No. 93. Sugar as Food. No. 94. The Vegetable Garden. No. 95. Good Roads for Farmers. No. 96. Raising Sheep for Mutton. No. 97. Experiment Station Work—X. No. 98. Suggestions to Southern Farmers. No. 99. Three Insect Enemies of Shade Trees. No. 100. Hog Raising in the South. No. 101. Millets. No. 102. Southern Forage Plants. No. 103. Experiment Station Work—XI. No. 104. Notes on Frost. No. 105. Experiment Station Work—XII. No. 106. Breeds of Dairy Cattle. No. 107. Experiment Station Work—XIII.